COMPETENCES AND ACCREDITATION IN ELECTRICAL AND INFORMATION ENGINEERING

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Abstract
With the continuing evolution of the academic landscape at the European level, it is important to propose some tools in order to enhance transparency and to measure the quality of curricula and student courses. The final purpose of the presented work is to give the students the possibility of practicing mobility during their studies and also to enhance the recognition of diploma in Europe and all around the world.
This work is achieved within the frame of the EIE-Surveyor (Reference Point for Electrical and Information Engineering in Europe). This ERASMUS thematic network comprises 110 European academic institutions and acts both as an observatory and a proposition force for this evolution, in the disciplinary fields of Electrical and Information Engineering. The project is granted by the EU Commission for a three-year period until October 2008.

Keywords: harmonisation, quality in engineering education, qualification, competences, accreditation

1. INTRODUCTION

Today, in various European countries, work is in progress to put the curricula in conformity with the Bologna-process scheme. Some of them (Italy, Czech Rep., some

French universities) are actually running it, others are in a process of restructuring like in Germany, and still others are in a reflection stage [1].
The aim of this process is to enhance and favour the mobility of students and academic staff, to facilitate the recognition of qualifications all around Europe, and to attract students coming from outside Europe through improved readability and comparability of degrees and their contents in Europe.

At the same time, the European Commission programmes encourage Higher Education Institutions (HEIs) to work together in the development of common or shared curricula and, notably, at the Master level to improve the emergence of international degrees and to tend to excellence under the frame of the ERASMUS MUNDUS programme [2].

The background of the project is based on the results of the *THEIERE* (Thematic Harmonisation in Electrical and Information EngineeRing in Europe) project (www.eaeeie.org/theiere) during which was set up an observatory on the implementation of the Bologna process in Europe, in Electrical and Information Engineering. This observatory resulted in a monograph [3] which was published and sent all around Europe (700 copies).

The other main outputs of the THEIERE project [4] were the development and proposition of pedagogical resources in Electrical and Information Engineering (http://www.eaeeie.org/theiere/pedagogical_resources.html), also aiming at harmonising the curricula for ODL [5] and life long learning processes.

Starting from the results of THEIERE, a new Thematic Network (TN) was launched. *EIE-Surveyor: Reference Point for Electrical and Information Engineering in Europe* (www.eie-surveyor.org) is a three-year European ERASMUS TN running since October 2005. The main objectives of this TN are:

- a reflection on generic competences and subject-specific competences in Electrical and Information Engineering (EIE)
- an implementation of quality assessment methodologies on some educational resources available in EIE
- a reflection and proposition of a methodology for accreditation, in order to enhance comparability and common certification procedures
- a census of the existing curricula in EIE in Europe, the multinational degrees, and the situation of the implementation of the Bologna-process in EIE, at the bachelor, master and PhD levels

Various target groups have been identified: professional engineering associations, life long learning institutions, students, teachers, employers and accreditation boards.

2. THE PARTNERSHIP

This TN comprises 110 European academic institutions representing 29 eligible countries (all the current EU countries except Luxembourg, plus Norway, Iceland, Bulgaria, Rumania and Turkey) and two countries not associated to the EU (Ukraine and Lebanon).

Besides the academic institutions other organisations are involved in the network:

- Some companies are present within the consortium: they will contribute in the definition of competences, and also participate in some developments relative to the use of new technologies for teaching.

- Some research institutes are members; also various laboratories which belong to universities are indirectly members since many partners, as academic teachers belong both to a department for teaching and a laboratory, within their universities.
- Several societies are partners, such as BEST (student association), EAEEIE (European Association for Education in Electrical and Information Engineering), IEEE French and German chapters on Education, French Club EEA.

3. ACTIVITIES OF THE PROJECT

EIE is actually the common substrate of all the most advanced technologies. Thus, an important point is to get an observatory on the implementation of the Bologna-process in EIE: a tool for feedback, but also for colleagues. The goal of the project is to become a reference point in EIE and, at the same time, to enhance the attractiveness of the European Research Area (ERA), the links with industry, and to contribute to the continuous evolution of higher education (HE) in Europe. To answer these needs, the main activities of the project, as identified in the contract, are described below.

3.1 Application of the *Tuning* methodology in the field of EIE in order to identify competences.

The objective is to complement the work done in other disciplines by the Tuning project [6, 7] itself and other TNs. The aim of the Tuning approach is to identify and quantify the fields which have to be taught to a student, the generic competences (line 1 of the Tuning approach) as well as the subject-specific competences (line 2 of the Tuning approach). Some reflections will be achieved also on Diploma Supplement.

Different questionnaires have been designed in order to ask students, employers, teachers and graduates, which are the main required competences for success in future careers. The questions asked deal with the perception of the importance of competences and the level to which these are developed within the degree programmes. It is foreseen that the provided information be very valuable in helping to improve planning for future students.

Concerning competencies, some links are notably established with TREE (Teaching and Research in Engineering in Europe) and EUCEET (European Civil Engineering Education and Training) as well as with other scientific and technological TN in the frame of the Archipelago [8] transversal action, particularly EEGECS (European Education in Geodetic Engineering, Cartography and Surveying) and USAEE (University Studies of Agricultural Engineering in Europe Thematic Network).

3.2 Analysis of existing accreditation procedures, proposition of a methodology.

To achieve this purpose, we will complete the study in order to have a better view on the accreditation procedures in the various European countries.

This is a strategic goal, if we want to go further in the recognition of qualifications all around Europe. This is not a simple task, since it turns out that similarity of degree-names does not guarantee similarity of competences attested by a certificate or some other form of qualification, let alone equivalence of qualifications. This might be illustrated by an example.

Many HEIs in Europe (and in the signatory states of the Washington Accord) grant a degree named „Bachelor of Electrical Engineering". Depending on the institution granting such a degree, the duration of study courses might range from 3 to 3,5 or 4 years. Even, if the duration of the course programs or the number of ECTS points required are the same, then there is no guarantee that contents or competences acquired during the course programmes are comparable on a broad basis.

Since Europe is having a manifold of links to the United States, we will also study the propositions of the American Board for accreditation.

Guidelines will be provided for good practices on accreditation based on the required competencies and industrial needs.

Initially the project team examined the outputs of the Euro-ACE project, which is specifically applicable to our field. Then, based on the most relevant findings of that project, a list of questions was developed. There were several exchanges between the task participants before they converged towards a final version of the questionnaire, which has been proposed to all the partners. In each participating country, a national representative will be in charge to gather the corresponding information.

There might be quite large differences in national accreditation procedures. There are countries having several competing accreditation agencies (e.g. Germany), others have one single agency, and still others do not (yet) have such an agency at all.

At the moment, the feedback from the questionnaires is collected. It will be analysed in order to define the common practices of evaluation. Based on this analysis, we will try to define the best common practice for the accreditation process.

3.3 Quality assessment of some resources in EIE available through Internet.

To reach this aim it is necessary, on one hand, to have web available specific materials, covering the required EIE topics. On the other hand, computer supported tools to use these materials in a suitable environment for attaining specific learning objectives and to allow different learning strategies (project based learning, collaborative/cooperative learning). This task deals with e-learning, both for life-long learning and initial education. To implement Quality in education here means to select and classify educational materials for EIE in the basis of:

- the quality of content in relation with the concepts, models and competencies required in EIE
- the potential effectiveness as teaching-learning tools for EIE education

and finally, to make them available to the EIE community.

3.4 Observatory on the degrees available in EIE in Europe, and state of the implementation of the Bologna-process

The objectives of the task are to provide information and synthesis on the existing curricula in EIE in Europe, and also to get a snapshot of the implementation of the Bologna-process in Europe in our disciplines. The main purpose is to have a better understanding of the present and evolving situation and to provide this information to other universities in Europe and also outside Europe: it will be possible so to enhance the attractiveness of the European HEI and curricula landscape to extra-European students.

In the curricula we are interested in, two kinds of difficulties could be identified:

- The first are structural difficulties due to the fact that higher education systems are different from one country to another one, and also because the diploma accreditation procedures are also different. This set of difficulties has to be identified for us, in order to well understand the various national practices.
- The second concerns some fundamental aspects of the field or pedagogical approach: it is interesting for us, as "specialists", to identify what are the difficulties at the moment to think about or elaborate common or shared curricula.

This study is made in 2 stages. The first stage is to identify the present structures of institutions, curricula, diploma and gateways in the various European systems, in order to have a common global view. The second point consists in characterising with more details the contents of the curricula/diploma in Electrical and Information Engineering thanks to a set of disciplines/keywords (i.e. a common glossary).

Starting from the monographs developed during the THEIERE TN (2000-2003), and THEIERE-DISS TN (2004-05) projects, the aim is to complete the missing information as well as to update the existing one, because the situation is always evolving.

PhD programs will be added, together with the identification of the existing links between masters and PhDs, taking into account the master courses which will prepare the students for PhD programs. In some countries (e.g. Germany and Austria), PhD programs (in engineering) are not seen as study programs. They are rather seen as a first phase in a professional career as an executive manager or in a research institution. In other countries, PhD programs in engineering are seen as study programs with more guidance by supervisors in charge.

In addition to the above mentioned information, a census of the existing international curricula in EIE will be integrated in the monographs.

This task also includes a survey about mobility in order to build-up a portal that underlines the key issues to improve mobility in our fields.

As shown in Figure 1, we want to point out that core activities deal with competencies (*Tuning* activity) which are an important element for the implementation of accreditation procedures, the means to reach this purpose being the Bologna process approach.

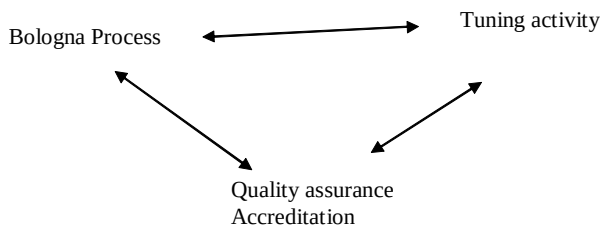

Figure 1: The role of competencies in the Bologna process

The project includes a reflection on how we can attract students to the scientific studies (particularly in EIE) and especially how to attract women, since women are less present in our disciplines. Contacts have been established with the TN on Women Studies (*Athina*) and with *PROMETEA* (Empowering Women Engineering Careers in Industrial and Academic Research)

4. PLANNED OUTPUTS

The main planned outputs of this three-year project are:

- Guidelines for contents as well as for generic competences and subject-specific competences in EIE
- Guidelines for a proposition for an accreditation methodology, together with a census on accreditation boards and methodologies
- A data-base of selected pedagogical resources available in EIE, including quality assessment.
- Update of the monograph on the degrees and international degrees available in EIE in Europe + a web-database version
- Update of the monograph on the Doctoral studies in Europe.

5. CONCLUSIONS

The purpose of this TN is to participate in the setting of the academic world for tomorrow. Several tools and methodologies are studied and proposed by the whole consortium, representative of the various countries and academic systems, the various subfields of Electrical and Information engineering, and the various levels (Bachelor-Master-Doctorate) of the Bologna process.

Several aspects will also be studied in partnership and coherence with other scientific and technological TNs (TREE, EUCEET, EEGECS, USAEE…) in the frame of the Archipelago transversal action.

The project running and results are constantly evaluated thanks to the setting of a monitoring group, including both internal and external reviewers. Various potential end-users (students, accreditation boards) will be requested for this evaluation.

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Curriculum Vitae (CV)

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Jean-Marc THIRIET is presently Full Professor at Université Joseph Fourier Grenoble. He was previously associate professor in Université Henri Poincaré Nancy 1. His teaching activities deal with networks, signal processing, computer. He is responsible of a Bachelor in "Networks and Telecommunications". He has a strong involvement ERASMUS thematic network activity, being the co-ordinator of the EIE-Surveyor Thematic Network www.eie-surveyor.org. His research activities (in GIPSA-Lab UMR 5216) includes study of networked control systems (NCS), evaluation of dependability of NCS, co-design network-diagnosis.

J.V. Benlloch-Dualde
José V. Benlloch-Dualde is associate professor at Technical University of Valencia, Spain, in the Department of Computer Engineering (DISCA) since 1987. His teaching activities deal with Computer Technology and Multimedia Systems. He belongs to the Computer Vision group and his research interests include computer vision, multimedia systems and engineering education. As a council member of the EAEEIE, he is actively engaged in international projects on higher engineering-education.

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Tony Ward is Deputy Head of Department and Senior Lecturer in Engineering Management in the Department of Electronics at the University of York. In the Department he has specific responsibility of the development of behavioural and managerial skills. He is the Director of the White Rose Centre for Excellence in Teaching and Learning in Enterprise at York, a centre dedicated to the development of an enterprise culture across the University. Tony's research interests are in the development of student skills and entrepreneurship. He is also the President of the EAEEIE and has been involved in a number of EU funded projects including previous EAEEIE Thematic Network projects.

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Olivier Bonnaud is full Professor at University of Rennes1 and SUPELEC Rennes since 1984. His teaching activities deal with microelectronics technology and process, physics of semiconductors and devices. He is responsible of a Master

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M. Hoffmann

Michael H.W. Hoffmann obtained the Diplom-degree (comparable to an M.Sc. degree) in physics in 1975 and his Ph.D. in RF & Microwave Engineering in 1980, both at Saarland University, Germany where he worked as a research assistant until 1983. He worked for six years in telecommunications industry. Since 1991 he is a professor and vice-head in the Institute of Microwave Techniques at the University of Ulm, Germany. As a council member of the EAEEIE, he is actively cooperating in international and national projects on modern higher engineering-education. He is a member of the IEEE, ITG, and VDE. He is vice-president of the German council of university departments of Electrical and Information Engineering (FTEI).